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RTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

Folwell Avenue, St. Paul, Minnesota 55101

# SEEDING BLACK SPRUCE ON BRUSHY LOWLAND SUCCESSFUL IF VEGETATION DENSITY KEPT LOW

ABSTRACT.—A study of direct seeding black spruce on brushy lowland in north-central Minnesota indicates reduction of vegetation regrowth, rather than seedbed preparation, is the major requirement for success.

OXFORD: 232.33:232.21:174.7(776) *Picea mariana*.
KEY WORDS: *Picea mariana*, reforestation, seedbed preparation, vegetation regrowth, leaf litter.

Reforesting the Lake States' 2 to 3 million acres of brushy lowland is desired and should be possible because much of it was occupied by black spruce *Picea mariana* (Mill.) B. S. P.) before logging. Many nonstocked areas contain scattered seed trees or are adjacent to mature stands, and so have been exposed to natural seeding. However, black spruce reproduction remains sparse, apparently because seedbed conditions are unfavorable. Planting has also generally failed on brushy lowland in the past, so direct seeding was studied as an alternative.[1]

The objective was to find out what seedbed conditions are required for successful seeding of black spruce. A typical brushy lowland was selected in north-central Minnesota, and several seedbed treatments were applied to small plots where seedling and environmental variables were measured during one growing season.

[1] *Planting was also studied but the results were published previously (Johnston 1970).*

## PROCEDURE

The study was made in a brushy lowland near Big Falls, Minnesota, where a well stocked stand of black spruce had been clearcut 10 years earlier.[2] The vegetation was mainly dense clumps of speckled alder (*Alnus rugosa* (Du Roi) Spreng.) interspersed with patches of grass and sedge (fig. 1). The ground surface was a typical mosaic of sphagnum moss and leaf litter underlain by organic soil about 1 m. deep.

*Figure 1.—Edge of brushy lowland near study area and part of black spruce stand that occupied area 10 years earlier.*

[2] *The cooperation of Minnesota's Division of Lands and Forestry is gratefully acknowledged.*

Seedbed treatments were applied to 32 plots (2 sq. m. each) of sphagnum moss (mainly *Sphagnum magellanicum* Brid. and *S. recurvum* Beauv.) and 32 plots of shrub leaf litter (mainly alder leaves). The plots of each surface type were prepared in May as follows: eight were compacted, eight were scalped, eight were burned, and eight were left untreated. Compacting with a hand tamper lowered the surface 10 to 15 cm. Scalping with a sharp-bladed rake removed 10 to 15 cm. of loose surface material. Burning also removed 10 to 15 cm. of material, but the material had to be taken indoors and dried before it could be burned satisfactorily on the plots. All vascular plants were cut and removed initially on the treated plots. Four of the eight plots in each group, including untreated seedbeds, were then kept unshaded by frequently clipping the vegetation regrowth. The other four plots were shaded — by regrowth on treated plots and by existing vegetation on untreated plots.

Each plot had one seed spot (23 cm. in diameter), which was sown on June 1 with 50 black spruce seeds averaging 96 percent viability. Seeds and resulting seedlings were protected from small mammals throughout the growing season by exclosures that did not shade the seed spots (Wagg 1964). Birds were excluded only during germination (first 5 weeks) by hardware cloth. Seedlings were inspected and counted weekly at first and later every 2 weeks until fall, when all survivors were lifted for measuring growth. Light intensity at seedling height was measured with an illumination meter on a cloudless, midsummer day on each seed spot. Water available to seedlings (retained at suctions of less than 15 bars) was determined for the top 5 cm. of the seedbed every 2 weeks on each plot; this was done using volumetric sampling and laboratory methods for organic soil (Boelter 1964). Maximum temperatures of seedbed surfaces were measured weekly on each seed spot using small temperature pellets (Silen 1956).

## RESULTS

Seedling weight was about three times greater on unshaded seedbeds than on shaded seedbeds at the end of one growing season (table 1). This is attributed to the lesser light intensity on shaded seedbeds. Vegetation regrowth was so rapid on the treated seedbeds that seedlings were getting an average of only 22 percent of full light by midsummer (fig. 2). This was about the same light intensity as that under existing vegetation on untreated seedbeds.

*Table 1.—Average ovendry weight per seedling at end of one growing season (In milligrams)*

| Seedling component | Sphagnum seedbeds | | Litter seedbeds | |
|---|---|---|---|---|
| | Unshaded | Shaded | Unshaded | Shaded |
| Shoot | 9.4 | 3.5 | 12.9 | 6.0 |
| Root | 5.2 | 1.2 | 7.3 | 1.8 |
| Total | 14.6 | 4.7 | 20.2 | 7.8 |

Seedling percent, or the number of living seedlings present for each 100 viable seeds sown, was considerably higher on sphagnum seedbeds than on litter seedbeds at the end of one growing season (table 2). Both seed germination and seedling survival, which together determine seedling percent, were also higher on sphagnum seedbeds. This greater success on sphagnum seedbeds is attributed to their greater water supply throughout the growing season. Water available in the top 5 cm. of untreated and treated sphagnum averaged 4 and 11 percent higher (by volume) than in untreated and treated litter, respectively.

*Table 2.—Average seedling percent at end of one growing season*

| Seedbed treatment | Sphagnum seedbeds | | Litter seedbeds | |
|---|---|---|---|---|
| | Shaded | Unshaded | Shaded | Unshaded |
| Scalped | 28 | 34 | 5 | 2 |
| Compacted | 19 | 56 | 17 | 13 |
| Burned | 21 | 9 | 9 | 0 |
| Untreated | 11 | 14 | 0 | 0 |

Within the sphagnum type, seedling percent is of practical interest only on the shaded seedbeds because shade from vegetation regrowth is inevitable. Among these seedbeds, scalped sphagnum had the highest seedling percent (table 2). This is attributed to the combined advantages that scalping had over the other seedbed treatments. First, scalping removed the living moss and thus prevented seedling mortality

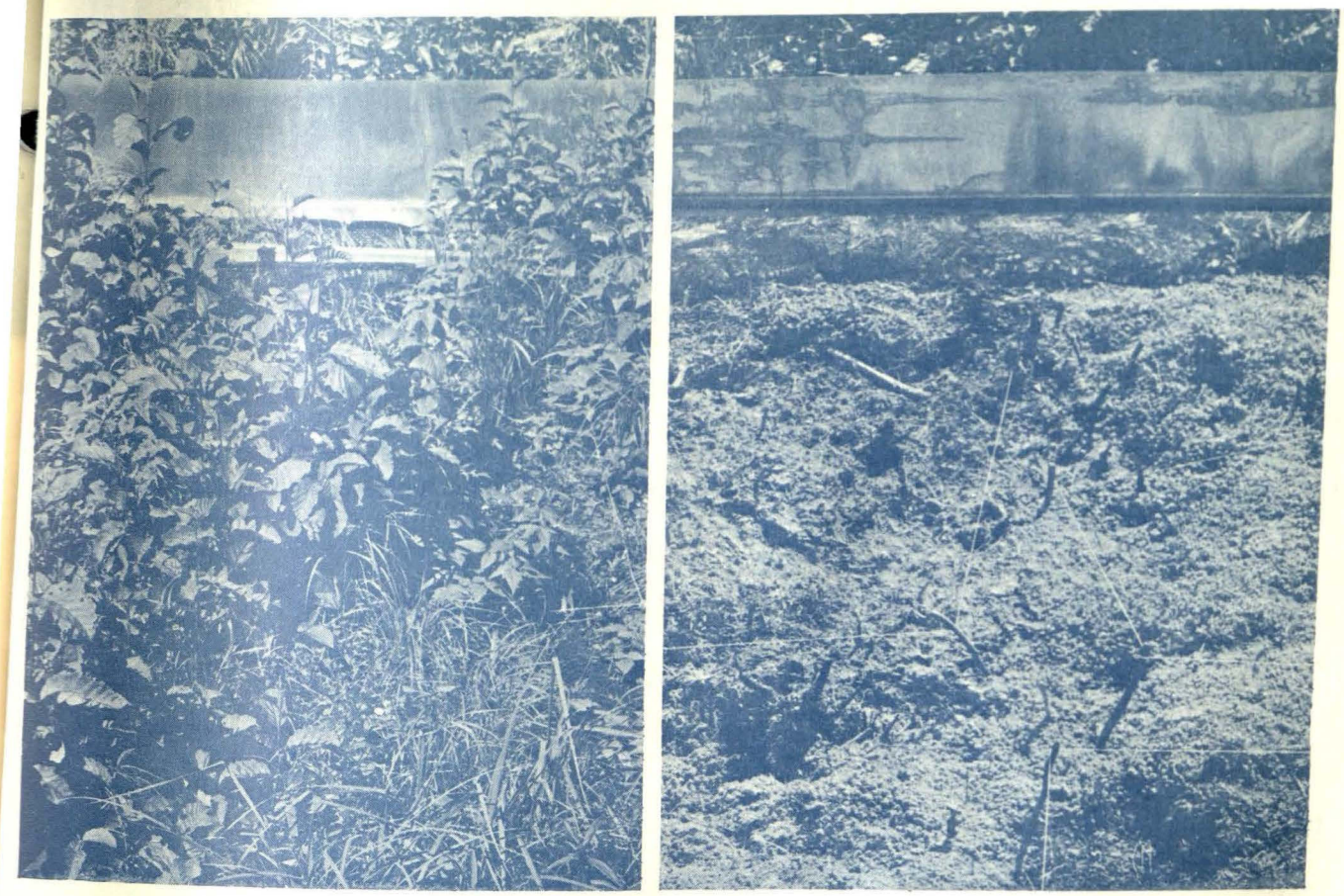

*Figure 2.—Typical plots in mid-August shaded by vegetation regrowth (left) and kept unshaded by frequently clipping regrowth (right). Top of small mammal exclosure in background is about 60 cm. high.*

caused by moss smothering. In contrast, such mortality was high on shaded seedbeds of untreated and compacted sphagnum. Second, scalping exposed a soil surface that was more favorable for seedling survival than the ash layer produced by burning. This surface had fewer occurrences of lethal temperatures (more than 125° F.) and seemed to stay wetter.

## DISCUSSION

The results of this study indicate that reduction of vegetation regrowth, rather than seedbed preparation, is the major requirement for successful direct seeding of black spruce on brushy lowland. For example, seedling percent may be good on scalped sphagnum at the end of one growing season, but failure is inevitable because rapid regrowth (1) reduces light intensity well below that required for good seedling growth (Logan 1969) and (2) produces a heavy leaf fall that will smother many seedlings during winter. An efficient method is therefore needed to reduce vegetation regrowth and to keep it low until seedlings become established.

Scalping deeper than 10 to 15 cm. would remove more roots and so should help reduce vegetation regrowth. Such scalping should also expose favorable seedbeds whether the ground surface is sphagnum

moss or leaf litter. But care must be used to prevent flooded seedbeds, because the water table is usually near the surface in brushy lowlands. After seeding, herbicide spraying is probably the most practical way to kill back vegetation regrowth and thus keep its density low. Specific recommendations on deeper scalping and herbicide spraying will require additional research, however.

Finally, cost data are needed to determine whether direct seeding or planting is cheaper for reforesting black spruce on brushy lowland. This would require pilot-scale trials for comparing the total cost of scalping, seeding, and herbicide spraying with the total cost of transplants, careful planting in sphagnum moss, and herbicide spraying (Johnston 1970).

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WILLIAM F. JOHNSTON
Silviculturist
Northern Conifers Laboratory
Grand Rapids, Minnesota
(Laboratory maintained in cooperation with the University of Minnesota)



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